Multi-rig Trawl on Peat and Clay Exposures

Introduction

The Assessing Welsh Fisheries Activities Project is a structured approach to determine the impacts from current and potential fishing activities, from licensed and registered commercial fishing vessels, on the features of Marine Protected Areas.

1. Gear and Feature	Multi-rig Trawl on Peat and Clay Exposures
2. Risk Level	Purple (High risk)
3. Description of Feature	Peat and Clay Exposures are comprised of several relevant biotopes (see annex 1 for full biotope descriptions). LR.HLR.FR.RPid refers to littoral peat and is characterised by the presence of a variety of boring piddocks. LR.MLR.MusF.MytPid refers to littoral firm clay characterised by small clumps of *Mytilus edulis, Ekminius modestus* and *Littorina littorea* on the surface. This habitat includes littoral and sublittoral examples of peat and clay exposures, both of which are soft enough to allow them to be bored by a variety of piddocks, particularly *Pholas dactylus*, *Barnea candida* and *Barnea parva*. Peat and clay exposures with either existing or historical evidence of piddock activity are unusual communities of limited extent, adding to the biodiversity interest where they occur. These unique and fragile habitats are irreplaceable, arising from former lake bed sediments and ancient forested peatland (or 'submerged forests'). Depending on erosion at the site, both clay and peat can occur together or independently of each other. Where peat is present on the shore or in shallow waters, the surface may be characterised by algal mats consisting of the red seaweed *Ceramium* spp. and the green seaweeds *Ulva lactuca* and *Ulva intestinalis*. However, sand scour can limit the cover provided by these seaweeds. The crabs *Carcinus maenas* and *Cancer pagurus* often

	occur in crevices in the peat, with hydroids in any small pools. On clay, seaweed cover is generally sparse with species such as *Mastocarpus stellatus* and *Ceramium* spp. attached to loose-lying pebbles or shells. On the surface of the clay, there may be small clumps of the mussel *Mytilus edulis*, together with barnacles and the winkle *Littorina littorea*. The polychaete worms *Polydora* spp. and *Hediste diversicolor* can sometimes be present within the clay. When the piddocks have died, their holes provide a micro-habitat for species such as small crabs and anemones such as *Cereus pedunculatus* and *Aulactinia verrucosa*. It is known that peat and clay beds exist sublittorally, but the extent and maximum depth of this habitat is not known. There is little information on the communities associated with subtidal examples of peat and clay exposures, but the flora and fauna is likely to be different to those found associated with intertidal examples. It is possible that subtidal exposures of this habitat support communities, which may or may not include piddocks. Surveys of a subtidal peat and clay exposure in the Menai Strait recorded the piddock *Zirfaea crispata*, a sparse cover of hydroids (e.g. *Sertularia cupressina*, *Hydrallmania falcata*, *Tubularia indivisa* and *Nemertesia antennina*), and crabs – *Cancer pagurus*, *Necora puber* and *Carcinus meanas.* Depending on its location, this habitat can experience periodic inundation and emergence from sediments. This habitat encompasses examples of peat and clay exposures with either existing or historical piddock activity (i.e. dead shells in piddock holes). This habitat also encompasses occurrences of peat and clay exposures with no evidence of either past or present piddock activity, but which have the potential for this community to develop on the basis of environmental conditions and presence of similar beds locally (BRIG, 2008). Following storms when the peat habitat may be covered in sand there may be a reduction in the amount of algal species.

	Many of the characterizing species that are present in the biotope are suspension/filter feeders, so productivity of the biotope would probably be largely dependent on detrital input (Tillin & Budd, 2008). Outcrops of fossilized peat in the littoral may project above sand level by >15cm and form extensive platforms up to 100m in length across the shore. Fossilized peat tends to be firm and relatively erosion resistant (Murphy, 1981). Many of the species associated with this biotope are commonly found on various shore types and are either mobile or rapid colonisers (Tillin & Budd, 2008).
4. Description of Gear	Otter/stern trawlers range in size from small, undecked boats, powered by outboard engines up to large vessels with up to 8,000HP engines (Galbraith *et al*, 2004). An otter trawl is a cone-shaped net that is towed over and remains in contact with the seabed. The net is usually towed from the stern of a vessel and comprises: a codend (which retains the catch), the body of the net, the mouth of the net with two lateral wings extending forward from the mouth of the net and connected to the boat via warps. The trawl mouth is kept open vertically by a headline with floats, it also has a ground rope (sweep/bridle) equipped with rubber discs, bobbins, spacers etc. to protect the trawl from damage. Tickler chains can be attached to the ground rope in certain fisheries to disturb the target species from the seabed into the net. The mouth of the net is kept open horizontally by two otter boards or 'doors'. These can be made of wood or steel and can be shaped differently depending on the type of vessel, water depth and target species. The 'flat' or 'v' shapped doors are mainly used by inshore vessels. The weight of the doors vary depending on the size of the net and the power of the vessel. During fishing operations the doors and the ground rope/chain are in constant contact with the seabed as this helps to disturb the fish and send them upwards into the mouth of the net.

	The door size will vary depending on the power and size of the vessel and the net being used. The weight of the doors will depend on the material used in their construction e.g wooden doors are usually made from hardwood planks over an inch thick, these doors will be heavier than softwood construction but lighter than steel construction (SEAFISH). The area of seabed impacted by the doors will depend on the angle of the doors to the net. When a door is 4m long, the width of the track is about 2m with a door angle of 30 degrees. The track can be made narrower by reducing the angle of the door to the net or by altering the height/length ratio of the door (FAO). The penetration depth of otter trawl gear components range from 2-10cm in sand sediments and 2-35cm in muddier sediment (Eigaard *et al*, 2016). On very rough seabed special rock hopper gear can be used. The rockhopper gear is simply the heavy fibre ground rope furnished with rubber discs or rubber wheel rollers (bobbins) and spacers which roll over small obstructions or rough ground. Otter trawls generally cover a greater area of ground than beam trawls (MMO, 2014). The ground rope will have the most extensive contact with the seabed, with the length of the ground rope depending on the size of the gear. **Multi-rig trawling** is the method of towing two or more otter trawls side-by-side by one vessel. Multi-rig trawls can be towed with either a 2 or 3 warp system depending upon the capabilities of the vessel’s winch. The basic rig is, similar to a single net rig, with trawl doors on each outside warp to spread the gear and a clump weight on the tail of the centre warp to keep the gear in contact with the seabed. Between the doors and clump weight the two nets are towed side by side. The amount of bridle (sweep) between the net and doors and net and weight depends on the type of seabed worked and the target species.

	The centre weight can range from a simple clump of heavy chain to a specialist depressor style weight and is usually about 25%-50% heavier than one door. The multi-rig clump can have a penetration depth of between 3-15cm in both sand and mud sediments (Eigaard *et al*, 2016). To keep both nets square and in their most efficient mode, the centre wire has to be shortened slightly. The amount depends on the length of wire between the doors and the vessel and the door spread (Seafish, 2011). The demersal trawl door is designed to hydrodynamically spread the mouth of a trawl and to have sufficient weight to ensure that the trawl gear maintains contact with the seabed. The roller clump is designed to distribute the towing force of the central warp between the two gears of a twin trawl and again have sufficient weight to ensure that the gears maintain contact with the seabed. These are the heaviest individual components of a trawl gear and are expected to have the greatest physical impact on the seabed (Ivanovic *et al*, 2011). A multi-rig designed for catching prawns covers a smaller area than a single trawl due to the low headline (~ 0.5 fathom) and reduced sweep length (Holst & Revill, 2009).
5. Assessment of Impact Pathways: 1. Damage to a designated habitat feature (including through direct physical impact, pollution, changes in thermal regime, hydrodynamics, light etc). 2. Damage to a designated habitat feature via removal of, or other detrimental impact on, typical species.	There are a lack of studies specifically investigating the impacts of multi-rig trawling on peat and clay exposures; therefore it is necessary to widen the research parameters to include other comparable bottom contacting mobile gear and habitats. **1.** Demersal mobile fishing gear reduces habitat complexity by: removing emergent epifauna, smoothing sedimentary bedforms, and removing taxa that produce structure (Auster & Langton, 1999). Demersal otter trawl gear has a direct physical effect on the seabed wherever the ground rope, chains and bobbins, sweeps, doors and any chaffing mats or parts of the net bag contact with the seabed. Ways in which gear affects the seabed can be classified as: scraping and ploughing; sediment resuspension; and physical destruction, removal, or scattering of non-target benthos (Jones, 1992).

	Gears such as beam trawls and scallop dredges, are designed specifically to disturb surface sediments to increase the catch rate of the target species (Kaiser *et al*, 1996). Hall *et al* (2008) conclude that significant and long-lasting if not permanent damage may be caused by a single pass of the gear. Dermersal trawls can cause damage to this habitat by scraping away the surface layer, continuous contact will eventually erode the peat and clay reducing the habitat. Kaiser *et al* (2002) suggest that deep water habitats, such as mud are more adversely affected by trawling activities due to the fact that they are often relatively undisturbed by wave turbulence and meteorological impacts. This would also apply to sheltered peat and clay habitats. This theory is supported by research conducted by Hiddink *et al* (2006) into impacts of bottom towed trawl activity to disturbance of benthic biomass. **In conclusion,** the peat and/or clay habitat may be degraded by a single pass of a multi-rig trawl. Continued impacts from multi-rig trawl gear will erode and remove more of the habitat, if the peat and/or clay is eventually removed entirely, recovery will not occur. **2.** Demersal mobile fishing gear reduces habitat complexity by: removing emergent epifauna, smoothing sedimentary bedforms, and removing taxa that produce structure (Auster *et al*, 1996). Demersal trawls cause direct mortality to non-target organisms through gear impact on the seabed (Bergman & van Santbrink, 2000). Where mussels are present on the peat and/or clay exposures, a single pass of the gear will penetrate the substrate and the mussel matrix and cause ecological damage to mussel beds and non-target fauna (Hall *et al*, 2008). Piddocks (Pholadidae), a bivalve mollusc which burrows in the sediment live within the peat and clay habitat. Old or vacated burrows

		create microhabitats for other species such as crabs and anemones, increasing the local biodiversity (Wright, 2015). Piddock shells are thin and easily broken. Collie *et al* (2000) undertook an analysis of published research into fishing activity impacts on the seabed, based on 39 research projects undertaken previously. They found an average of 46% decrease in total number of species individuals within the study sites that were disturbed with bottom towed gear **In conclusion** multi-rig trawling on peat and clay exposures could cause degradation of the feature and removal of typical species. Where part of the feature remains, recolonization could occur rapidly. If the feature is removed, no typical species can recolonise.
6. MPAs where feature exists	**Carmarthen Bay and Estuaries SAC**	Mid-Flandrian peat is present intertidally southwest of Amroth, Maross Sands, Pendine, both intertidally and subtidally in the Gwendraeth, at Whiteford Point, Broughton Bay and in the Burry Inlet at Llanridian Sands, at Port Eynon Bay and along the River Loughor (CCW, 2009a).
	Menai Strait and Conwy Bay SAC	An unusual subtidal reef habitat of clay deposits occurs subtidally near Gallows Point just west of Beaumaris and another outcrop has been recorded between Beaumaris and Penmon (CCW 2009b). Intertidal peat and clay habitats can be found at various locations throughout the Menai Strait and also at Red Wharf Bay and near Moelfre. Intertidal peat and clay habitats are also be found beween Conwy Morfa and West Shore at Llandudno.
	Lleyn Peninsula and the Sarnau SAC	Intertidal exposures of peat and clay can be found within the SAC near Llanbedrog, the mouth of the river Artro, north of Barmouth, between Tywyn and Aberdovey and North of Borth (CCW, 2009c).
	Pembrokeshire Marine SAC	Intertidal exposure mapped with medium confidence at Castlemartin.

	Dee Estuary	There are two records within this SAC, one near Gronant and the other in the Dee estuary on the Wirral coast.

7. Conclusion

This habitat and its associated species are fragile and easily damaged by one pass of a multi-rig trawl. The irreplaceable nature of the peat and clay exposures means that, if erosion occurs to the habitat substrate by repeated passes of the multi-rig trawl gear, then recovery will not occur. Although the species associated with these habitats could be initially lost, recovery may be possible if some of the feature remained.

8. References

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Annex 1
Biotope descriptions (version 15.03) (JNCC - http://jncc.defra.gov.uk/marine/biotopes/hierarchy.aspx)

LR.HLR.FR.RPid - *Ceramium* sp. and piddocks on eulittoral fossilised peat
Outcrops of fossilised peat in the eulittoral are soft enough to allow a variety of piddocks such as *Barnea candida* and *Petricola pholadiformis* to bore into them. The surface of the peat can be characterised by a dense algal mat, predominantly the red seaweed *Ceramium* spp. and with the green seaweeds *Ulva lactuca* and *Enteromorpha intestinalis.* Damp areas in the algal mat are covered by aggregations of the polychaetes *Lanice conchilega* and *Polydora* sp. The crabs *Carcinus maenas* and *Cancer pagurus* occur in crevices in the peat. Small pools on the peat may contain hydroids, such as *Obelia longissima* and *Kirchenpaueria pinnata*, the brown alga *Dictyota dichotoma* and the crustacean *Crangon crangon*.

LR.MLR.MusF.MytPid - *Mytilus edulis* and piddocks on eulittoral firm clay
Clay outcrops in the mid to lower eulittoral which are bored by a variety of piddocks including *Pholas dactylus*, *Barnea candida* and *Petricola pholadiformis*. The surface of the clay is characterised by small clumps of the mussel *Mytilus edulis*, the barnacle *Elminius modestus* and the winkle *Littorina littorea*. Seaweeds are generally sparse on the clay, although small patches of the red seaweeds *Mastocarpus stellatus*, *Halurus flosculosus* and *Ceramium* spp. can occur, usually attached to loose-lying cobble or mussel shells. Also the green seaweeds *Enteromorpha* spp. and *Ulva lactuca* may be present. The sand mason *Lanice conchilega* can sometimes be present in the clay, while the shore crab *Carcinus maenas* is present as well.

CR.MCR.SfR – Soft rock communities
This biotope complex occurs on moderately wave-exposed, circalittoral soft bedrock subject to moderately strong tidal streams. As this complex is found in highly turbid water conditions, the circalittoral zone may begin at the low water mark, due to poor light penetration. This complex is dominated by the piddock *Pholas dactylus*. Other species typical of this complex include the polychaete *Polydora* and *Bispira volutacornis*, the sponges *Cliona celata* and *Suberites ficus*, the bryozoan *Flustra foliacea*, *Alcyonium digitatum*, the starfish *Asterias rubens*, the mussel *Mytilus edulis* and the crab *Necora puber* and *Cancer pagurus*. Foliose red algae may also be present. Three biotopes have been identified within this complex: Pid, Pol and Hia.

CR.MCR.SfR.Pid – Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay
This biotope occurs on circalittoral soft rock, such as soft chalk or clay, most often in moderately exposed tide-swept conditions. As soft chalk and firm clay are often too soft for sessile filter-feeding animals to attach and thrive in large numbers, an extremely impoverished epifauna results on upward-facing surfaces, although vertical faces may be somewhat richer. The rock is sufficiently soft to be bored by bivalves. Species vary with location, but *Pholas dactylus* is the most widespread borer and may be abundant. Other species present may include the sponges *Dysidea fragilis* and *Suberites carnosus* and the polychaete *Bispira volutacornis*. Foliose red algae may be present on the harder, more stable areas of rock. Mobile fauna often include the crabs *Necora puber* and *Cancer pagurus*.